



Genes and individual response to nutrients in bone health

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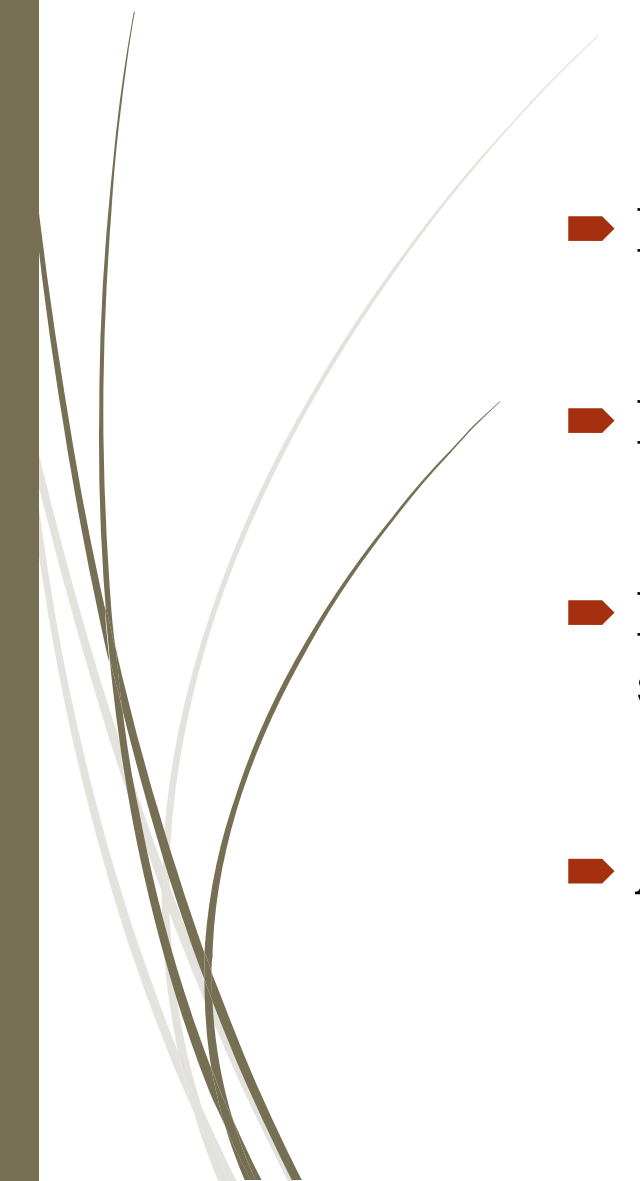


What does bone do?

- Provide support for our bodies and give it shape
- Protect body's internal organs
- Support muscles
- Store calcium and release when needed by the body
- Make blood cells (red and white blood cells)

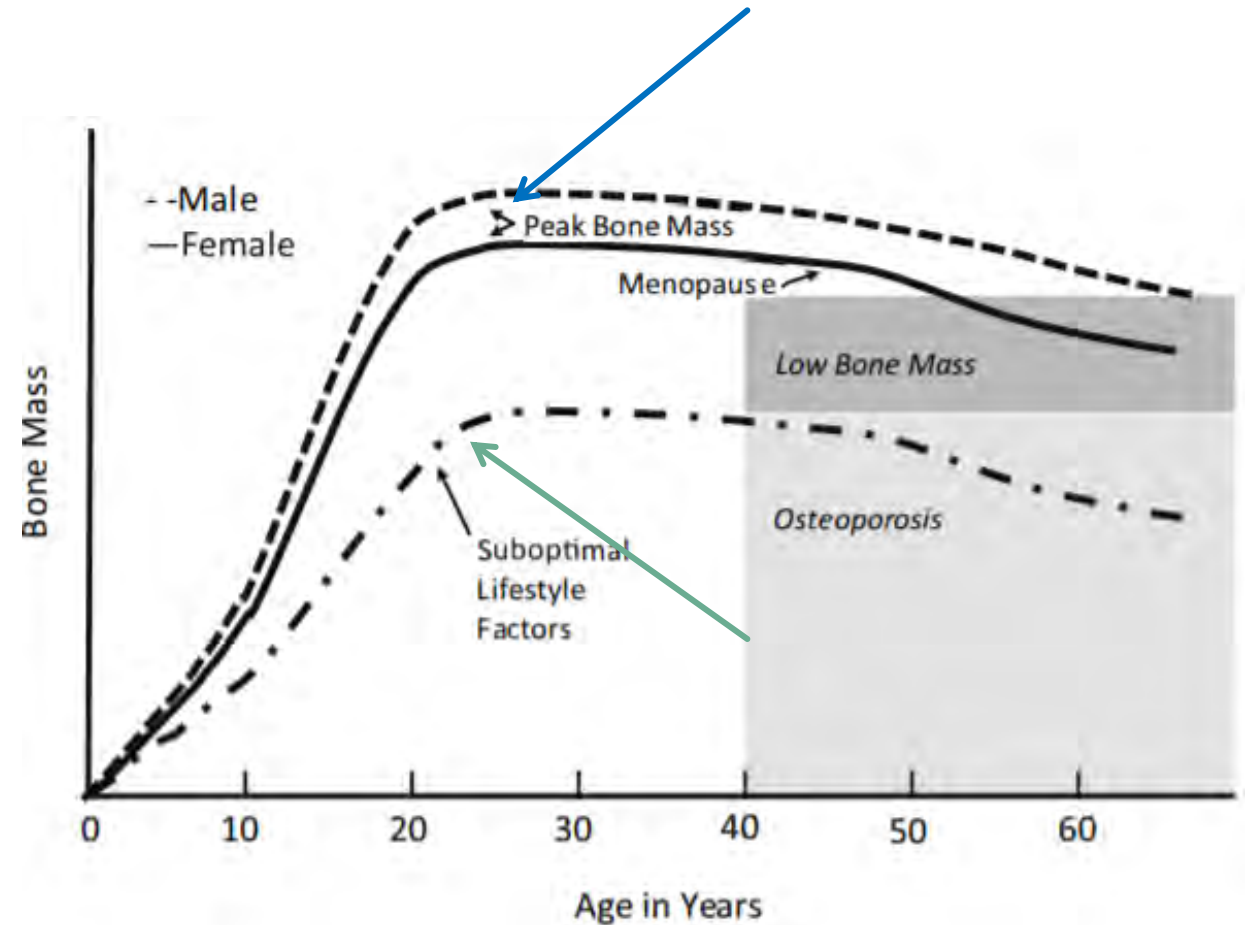


Why does bone health matter?

- Bones become weak if not properly cared for
 - Bones become weak with age
 - Broken bones (fractures) can be painful and need surgery to heal
 - Affect quality of life
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Peak bone mass

- The important modifiable determinant of lifelong skeletal health
- It's estimated a 10% increase of peak bone mass in children reduces the risk of an osteoporotic fracture during adult life by 50%.



What are the major bone problems?

Children

Rickets and scoliosis

Back pain

Bursitis

Gout

Low bone density

Paget's disease of bone



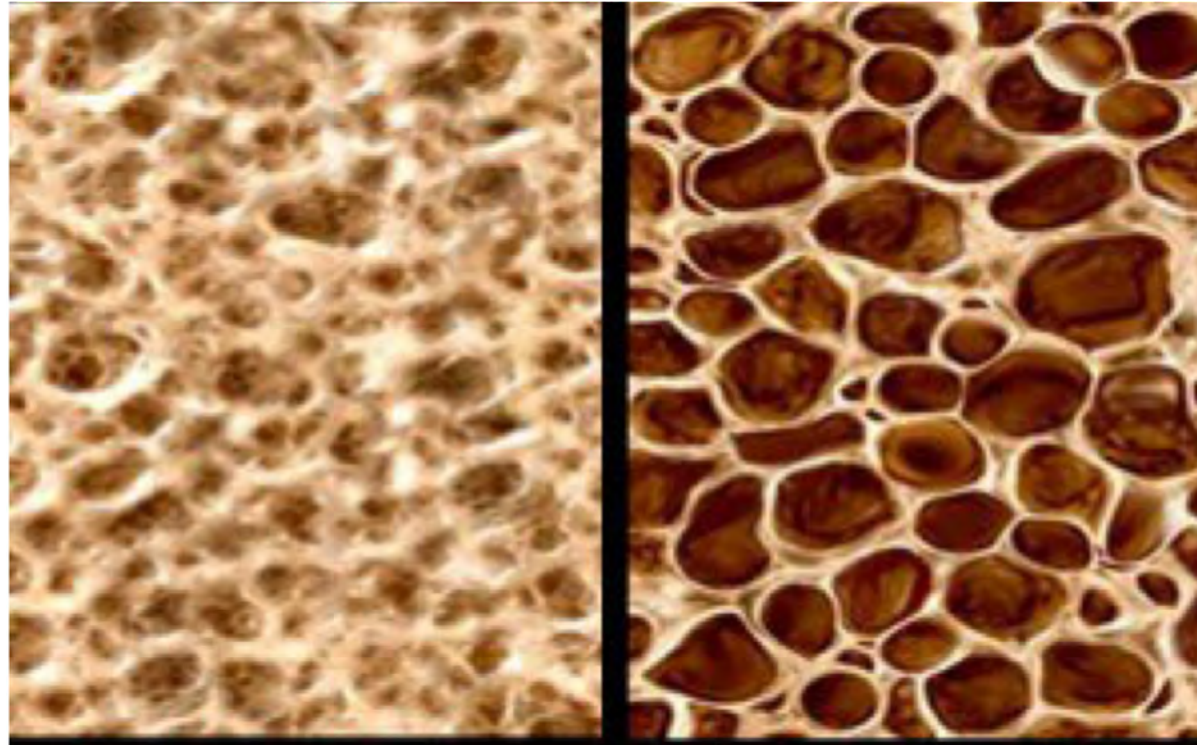
Osteoarthritis

Osteoporosis

Rheumatoid arthritis/lupus

Scoliosis

Others

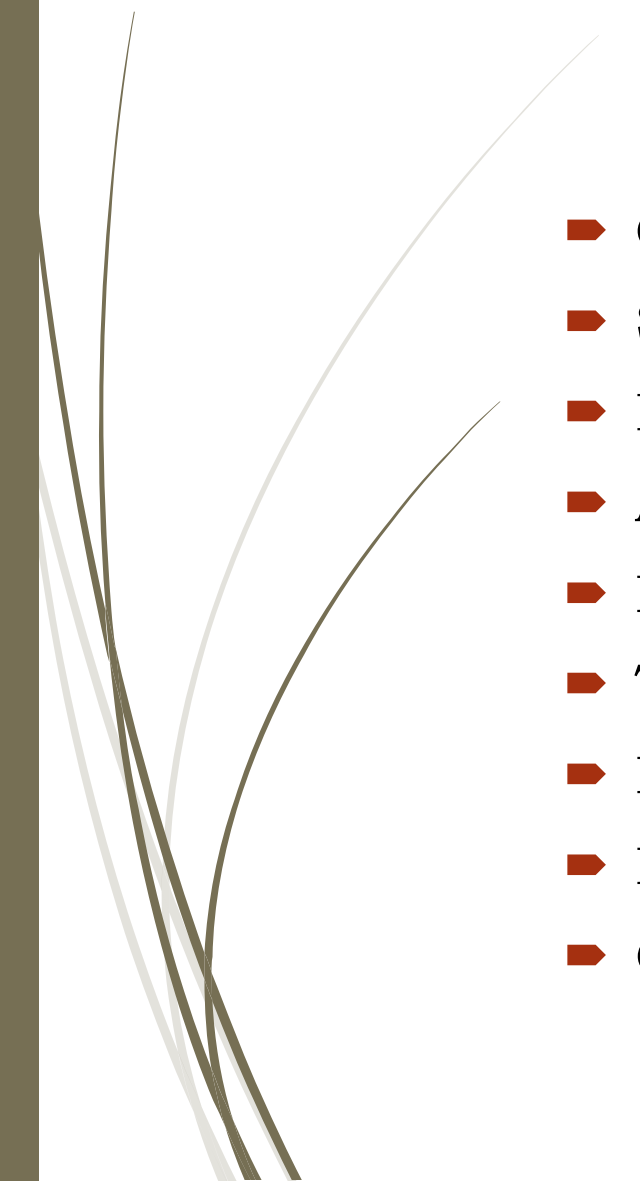


Healthy bone

Osteoporotic bone



What factors affect bone health?

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- Gender
 - Size
 - Race and family history
 - Amount of calcium in your diet
 - Physical activity
 - Tobacco and alcohol use
 - Hormone levels
 - Eating disorders
 - Certain medications



How diet and physical activity affect bone health?

Diet/nutrients

- Calcium (milk and other dairy products, green leafy vegetables, sardines, salmon, etc)
- Vitamin D (salmon, mackerel, tuna and sardines, etc)
- Magnesium (Green leafy vegetables, okra, tomatoes, artichokes, sweet potatoes, raisins, etc)

Physical activity

- Moderate to vigorous activity better than sedentary activity
- Weight-bearing
 - - high-impact – Dancing, high-impact aerobics, hiking, jogging, jumping rope, stair climbing, tennis
 - - low-impact – elliptical training, low-impact aerobics, stair-step machines, fast walking on treadmill or outside
- Muscle-strengthening exercises – lifting weights, weight machines, standing, rising up on your toes
- Strength, balance and flexibility – yoga, pilates, etc

How genes affect bone health?

- ▶ Bone mass is strongly influenced by heredity
- ▶ Bone mass is affected by multiple genes
 - Bone mineral density and fracture – **VDR**, *IL-6*, *COMT*, *LRP5*, *ER α* , *DAAM2*, *CBW1*, *WAC*, *RGCC*, *YWHAE*
 - Osteoporosis – **VDR**, *DARC*, *COL1A1*, *TGF β 1*, *Scleostin*, *TCIRG1*, *LRP5*, *ER α* ,
 - Osteoarthritis – *COL1A1*, *COMP*, *IL1 β* , *IL6*, **VDR**, *ER α* , *IGF-1*, *CALM1*, *FRZB*, *ASP*, *AGC1*, *TGF β 1*
 - Gout – *SLC2A9*, *ABCG2*, *SLC22A12*, *MAF*, *ALDH16A1*, *TLR4*, *AOX1*, *CYP2C9*
 - Rheumatoid arthritis – *PTPN22*, *IL23R*, *TRAF1*, *CTLA4*, *IRF5*, *STAT4*, *CCR6*, *PAD14*, *HLA set of genes*
- ▶ Identification of genes and pathways involved in weakening of bones will help us identify treatment strategies



How genes and diet interact to affect bone health?

- ▶ Persons with a specific variant in a gene can have higher or lower bone mineral density based on their nutrient intake
 - *VDR* (BB, Bb, bb) persons with bb can have bone mineral density if they take > 800mg/day of calcium than those who take < 500 mg/day. But if someone has Bb or BB the effect is not clear*
 - *VDR* (BB, Bb, bb) Those with BB with high caffeine intake (> 300mg/day) can have greater bone loss long-term (over 3 years) than those with Bb or bb genotype*



What did we find in our research?

- ▶ Identify genes influencing bone health in children and how nutrition and physical activity affect this relationship
 - ▶ ~800 children of Hispanic ethnicity
 - ▶ Calcium intake was positively linked to bone mineral density
 - ▶ Stronger association was between genetic variants and bone mineral density
 - ▶ Children with higher moderate-vigorous physical activity has greater bone mineral density than others who had higher sedentary activity
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- ▶ Children with a specific set of genetic variants were more susceptible to low bone mineral density than others. These children benefited the most from moderate-vigorous physical activity and increased calcium intake.



Take home messages

- ▶ Low bone mass and strength lead to increased fracture risk
- ▶ Although bone mass is greatly influenced by genetics, nutrition and lifestyle factors can modify the effects of genetics
- ▶ Genetic factors can predispose individuals to bone loss even at a younger or early middle age
- ▶ Research on how genes regulate bone mass and metabolism and interact with diet is important in detecting the risk for osteoporosis much before the fractures happen.



What can I do to keep my bone healthy?

- Include plenty of calcium in your diet
- Get Vitamin D (diet or sunlight)
- Include physical activity in your daily routine
- Avoid tobacco, alcohol or any other substance abuse